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THE ROMANES LECTURE

1905

Nature and Man

BY

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NATURE AND MAN

MR. VICE-CHANCELLOR, MASTERS AND SCHOLARS OF THE UNIVERSITY OF OXFORD,

There are, I think, few who might be called upon to deliver the annual Romanes lecture before this ancient and glorious University who could feel more deeply sensible of the honour conferred on them than I do; few who could be more grateful for the kindness and consideration which the invitation to give this lecture, implies. And no one, I think, could be more keenly aware than I am of the responsibility of the task undertaken and of his own deficiency in those qualities which are needful in order that the lecturer may do justice to the occasion. Great and eloquent men, leaders of thought, some occupying high position in the State, have been among my predecessors. It is, then, with great diffidence that I address you. I cannot forget in doing so, that I have not only passed through early days at the knees of our Alma Mater, but have spent the best years of my life under her shelter, nourished and encouraged by her bounty, and that I am speaking to many who have been my friends and companions. Difficulties and anxieties of a special kind belong to such a situation. But I know from experience that I may count upon your forbearance and generosity, and I trust that whatever

criticism I may incur, the profession which I hereby make of reverence and affection for our University, and of true sympathy with those who to-day carry on her manifold labours, will be accepted as no mere formal statement, but as the expression of a deep-rooted sentiment.

It is a pleasure to me, at this moment, to call to mind my friendship with the gifted man who founded this lectureship, and to join my tribute with that of so many others, to his high qualities. The knowledge of Nature lost a true and eager searcher when his labours ceased.

1. Choice of a Subject.

In choosing a subject for the discourse which it is my privilege to deliver to-day, I have ventured to select one which has largely occupied the attention of biologists during the five and forty years in which I have followed the results of scientific discovery. The title which describes it must, I fear, seem unduly ambitious since Nature and Man comprise well-nigh every topic with which such a discourse can deal. My desire, however, is more modest than my advertisement. It has become more and more a matter of conviction to me—and I believe that I share that conviction with a large body of fellow students both in this country and other civilized states—that the time has arrived when the true relation of Nature to Man has been so clearly ascertained that it should be more generally known than is at present the case, and that this knowledge should form far more largely than it does at this moment, the object of human activity and endeavour

—that it should be, in fact, the guide of state-government and the trusted basis of the development of human communities. That it is not so already, that men should still allow their energies to run in other directions, appears to some of us a thing so monstrous, so injurious to the prosperity of our fellow men, that we must do what lies within our power to draw attention to the conditions and circumstances which attend this neglect, the evils arising from it, and the benefits which must follow from its abatement.

It is not unfitting that a son of Oxford should in the fullness of time place before his Alma Mater conclusions which he has formed on a matter of serious and far-reaching importance. Oxford has been said to be the home of lost causes. It is true that her hospitality and benevolence are such that she is the home both of causes which triumph and of causes which are defeated; but it may be more aptly said that it is her splendid distinction, when corrupting greed and glorified ignorance are so largely dominant in the national life, still to be the birth-place of high aspirations, still the shelter and sanctuary of noble ideals. I therefore, with confidence in the generosity of my audience, venture to lay before you what I have to say.

2. The word 'Nature.'

The signification attached to the word 'Nature' is by no means the same at the present day as it has been in the past: as commonly used it is a word of varied meanings and limitations, so that misconception and confusion are liable to be associated with it. By the professed student of modern sciences it is usually understood as a name for the entire mechanism of

the universe, the kosmos in all its parts; and it is in this sense that I use it. But many still identify 'Nature' with a limited portion of that great system, and even retain for it a special application to the animals and plants of this earth and their immediate surroundings. Thus we have the term 'natural history' and the French term 'les sciences naturelles' limited to the study of the more immediate and concrete forms of animals, plants, and crystals. There is some justification for separating the conception of Nature as specially concerned in the production and maintenance of living things from that larger Nature which embraces together with this small but deeply significant area, the whole expanse of the heavens in the one direction and Man himself in the other. Giordano Bruno, who a little more than 300 years ago stood here in Oxford where we are now met, was perhaps the first to perceive and teach the unity of this greater Nature, anticipating thus in his prophetic vision the conclusion which we now accept as the result of an accumulated mass of evidence. Shakespeare came into touch with Bruno's conception, and has contrasted the more limited and a larger (though not the largest) view of Nature in the words of Perdita and Polyxenes. Says Perdita:—

> '. . . the fairest flowers o' the season
> Are our carnations, and streak'd gillyvors,
> Which some call nature's bastards; of that kind
> Our rustic garden's barren; and I care not
> To get slips of them. . . . For I have heard it said,
> There is an art which, in their piedness, shares
> With great creating nature.'

To which Polyxenes replies:—

> 'Say there be—
> Yet nature is made better by no mean,

> But nature makes that mean: so, over that art,
> Which, you say, adds to nature, is an art
> That nature makes. You see, sweet maid, we marry
> A gentler scion to the wildest stock;
> And make conceive a bark of baser kind
> By bud of nobler race; this is an art
> Which does mend nature,—change it, rather: but
> The art itself is nature.'

The larger proportion of so-called educated people even at the present day have not got beyond Perdita's view of Nature. They regard the territory of Nature as a limited one, the play-ground or sport of all sorts of non-natural demons and fairies, spirits and occult agencies. Apart from any definite scheme or conception of these operations, they personify Nature and attribute a variety of virtues and tendencies to her for which there is no justification. We are told, according to the fancy of the speaker, that such a course is in accordance with Nature; that another course is contrary to Nature; we are urged to return to Nature, and we are also urged to resist Nature. We hear that Nature will find a remedy for every ill, that Nature is just, that Nature is cruel, that Nature is sweet and our loving mother. On the one hand Man is regarded as outside of and opposed to Nature, and his dealings are contrasted favourably or unfavourably with those of Nature. On the other hand we are informed that Man must after all submit to Nature and that it is useless to oppose her. These contradictory views are in fact fragments of various systems of philosophy of various ages in which the word 'Nature' has been assigned equally various limitations and extensions. Without attempting to discuss the history and justification of these different uses of the word Nature, I think that

I may ask those here present to allow me to use the word Nature as indicating the entire kosmos of which this cooling globe with all upon it is a portion.

3. Nature-searchers.

The discovery of regular processes, of expected effects following upon specified antecedents, of constant properties and qualities in the material around him, has from the earliest recorded times been a chief occupation of Man and has led to the attainment by Man of an extraordinarily complex control of the conditions in which his life is carried on. But it was not until Bruno's conception of the unity of terrestrial nature with that of the kosmos had commended itself that a deliberate and determined investigation of natural processes, with a view to their more complete apprehension, was instituted. One of the earliest and most active steps in this direction was the foundation less than 250 years ago of the Royal Society of London for the Promotion of Natural Knowledge, by a body of students who had organized their conferences and inquiries whilst resident in Oxford[1].

All over Western Europe such associations or academies for the building up of the New Philosophy (as it was called here) came into existence. It is a fact which is strangely overlooked at the present day, when the assumption is made that the acquirement of a knowledge of Greek grammar is the traditional and immemorial occupation of Oxford students—that until the modern days of the eighteenth century ('modern' in the history of Oxford) Greek was less known in Oxford than Hebrew is at present, and that the study of Nature —Nature-knowledge and Nature-control—was the appro-

priate occupation of her learned men. It is indeed a fact that the very peculiar classical education at present insisted on in Oxford, and imposed by her on the public schools of the country, is a modern innovation, an unintentional and, in a biological sense, 'morbid' outgrowth of that 'Humanism' to which a familiarity with the dead languages was, but is no longer, the pathway.

4. The Doctrine of Evolution.

What is sometimes called the scientific movement, but may be more appropriately described as the Nature-searching movement, rapidly attained an immense development. In the latter half of the last century this culminated in so complete a knowledge of the movements of the heavenly bodies, their chemical nature and physical condition, so detailed a determination of the history of the crust of this earth and of the living things upon it, of the chemical and physical processes which go on in Man and other living things, and of the structure of Man as compared with the animals most like him, and of the enormous length of time during which Man has existed on the earth, that it became possible to establish a general doctrine of the evolution of the kosmos, with more special detail in regard to the history of this earth and the development of Man from a lower animal ancestry. Animals were, in their turn, shown to have developed from simplest living matter, and this from less highly elaborated compounds of chemical 'elements' differentiated at a still earlier stage of evolution. There is, it may be said without exaggeration, no school or body of thinkers at the present day who are

acquainted with the facts now ascertained, which denies the orderly evolution of the kosmos by the regular operation of a more or less completely ascertained series of properties resident in the material of which it consists. The process of evolution—the interaction of these ascertainable, if not fully ascertained, properties—has led (it is held), in the case of the cooling cinder which we call the earth—by an inevitable and predestined course—to the formation of that which we call living matter and eventually of Man himself. From this process all disorderly or arbitrary interferences must, it seems, be excluded. The old fancies as to presiding demons or fairies, which it was imagined had for their business to interrupt the supposed feeble and limited efforts of Nature, as yet unexplored and unappreciated, have passed out of mind. The consensus is complete: Man is held to be a part of Nature, a product of the definite and orderly evolution which is universal; a being resulting from and driven by the one great nexus of mechanism which we call Nature. He stands alone, face to face with that relentless mechanism. It is his destiny to understand and to control it.

5. Unwarranted Inferences from the Evolution of Man.

There are not wanting those who, accepting this conclusion, seek to belittle Man and endeavour to represent that the veil is lifted, that all is 'explained,' obvious, commonplace, and mean in regard to the significance of life and of Man, because it has become clear that the kosmic process has brought them forth in due order. There are others who rightly perceive that life is no common property of our cooling matter,

but unique and exceptional, and that Man stands apart from and above all natural products, whether animate or inanimate. Some of these thinkers appear to accept the conclusion that if life and Man are regarded as products of the kosmic process—that is, of Nature—'life' and 'Man' lose so much in importance and significance that dire consequences must follow to Man's conception of his dignity and to the essential features of his systems of conduct and social organization. Accordingly they cling to the belief that living matter and Man have not proceeded from an orderly evolution of Nature, but are 'super' natural. It is found on the other hand, by many who have considered these speculations, and hold no less explicitly than do the 'supernaturalists,' that life is a momentous and peculiar feature of our earth's surface and Man the isolated and unparalleled 'piece of work,' 'the beauty of the world,' 'the paragon of animals'—it is found by many such, I say, that nothing is gained in regard to our conception of Man's nobility and significance by supposing that he and the living matter which has given rise to him, are not the outcome of that system of orderly processes which we call Nature.

There is one consideration in regard to this matter which, it seems, is often overlooked and should be emphasized. It is sometimes, and perhaps with a sufficient excuse in a want of acquaintance with Nature, held by those who oppose the conclusion that Man has been evolved by natural processes, that the products of Nature are arbitrary, haphazard, and due to chance, and that Man cannot be conceived of as originating by chance. This notion of 'chance' is a misleading figment inherited by the modern world

from days of blank ignorance. The 'Nature-searchers' of to-day admit no such possibility as 'chance.' It will be in the recollection of many here, that a leading writer and investigator of the Victorian Era, the physicist John Tyndall, pointed out in a celebrated address delivered at Belfast that according to the conceptions of the mechanism of Nature arrived at by modern science—the structure of that mechanism is such that it would have been possible for a being of adequate intelligence inspecting the gaseous nebula from which our planetary system has evolved to have foreseen in that luminous vapour the Belfast audience and the professor addressing it! The fallacy that in given but unknown circumstances anything whatever may occur in spite of the fact that some one thing has been irrevocably arranged to occur, is a common one[2]. It is correct to assume in the absence of any pertinent knowledge (if we are compelled to estimate the probabilities) that one event is as likely as another to occur; but nevertheless there is no 'chance' in the matter since the event has been already determined, and might be predicted by those possessing the knowledge which we lack. Thus then it appears that the conclusion that Man is a part of Nature is by no means equivalent to asserting that he has originated by 'blind chance': it is in fact a specific assertion that he is the predestined outcome of an orderly—and to a large extent 'perceptible'—mechanism.

6. Nature's Mode of Producing Organic Forms.

The general process by which the higher and more elaborate forms of life, and eventually man himself, have

been produced has been shown by Darwin to depend upon two important properties of living matter manifested in connexion with the multiplication of individuals. Living matter has a special property of adding to its bulk by taking up the chemical elements which it requires and building up the food so taken as additional living matter. It further has the power of separating from itself minute particles or germs which feed and grow independently, and thus multiply their kind. It is a fundamental character of this process of reproduction that the detached or pullulated germ inherits or carries with it from its parents the peculiarities of form and structure of its parent. This is the property known as Heredity. It is most essentially modified by another property—namely, that though eventually growing to be closely like the parent, the germ (especially when it is formed, as is usual, by the fusion of two germs from two separate parents) is never identical in all respects with the parent. It shows Variation. In virtue of Heredity, the new congenital variations shown by a new generation are transmitted to their offspring when in due time they pullulate or produce germs. Man has long been aware of this; and, by selecting variations of beasts, birds, or plants agreeable or useful to him, has intensified such variations and produced animals and plants in many features very unlike those with which he started.

It was Darwin's merit to show that a process of selection which he called 'Natural Selection' must take place in the free untouched conditions under which animals and plants exist, and have existed for ages, on this globe. Both animals and plants produce germs, or young, in excess—usually in va[illegible] The world, the earth's

surface, is practically full, that is to say, fully occupied. Only one pair of young can grow up to take the place of the pair—male and female—which have launched a dozen, or it may be as many as a hundred thousand, young individuals on the world. The property of Variation ensures that amongst this excess of young there are many differences. Eventually those survive which are most fitted to the special conditions under which this particular organism has to live. The conditions may, and indeed in long lapses of time must, change, and thus some variation not previously favoured will gain the day and survive. The 'struggle for existence' of Darwin is the struggle amongst all the superabundant young of a given species, in a given area, to gain the necessary food, to escape voracious enemies, and gain protection from excesses of heat, cold, moisture, and dryness. One pair in the new generation—only one pair—survive for every parental pair. Animal population does not increase: 'Increase and multiply' has never been said by Nature to her lower creatures. Locally, and from time to time, owing to exceptional changes, a species may multiply here and decrease there; but it is important to realize that the 'struggle for existence' in Nature—that is to say, among the animals and plants of this earth untouched by man—is a desperate one, however tranquil and peaceful the battle-field may appear to us. The struggle for existence takes place, not as a clever French writer[3] glibly informs his readers, between different species, but between individuals of the same species, brothers and sisters and cousins. The struggle between a beast of prey which seeks to nourish itself and the buffalo which defends its life with its horns is not 'the struggle for existence' so named by Darwin. More-

over, the struggle among the members of a species in natural conditions differs totally from the mere struggle for advancement or wealth with which uneducated writers so frequently compare it. It differs essentially in this—that in Nature's struggle for existence, death, immediate obliteration, is the fate of the vanquished, whilst the only reward to the victors—few, very few, but rare and beautiful in the fitness which has carried them to victory—is the permission to reproduce their kind—to carry on by heredity to another generation the specific qualities by which they triumphed.

It is not generally realized how severe is the pressure and competition in Nature—not between different species, but between the immature population of one and the same species, precisely because they are of the same species and have exactly the same needs. From a human point of view the pressure under which many wild things live is awful in its severity and relentless tenacity. Not only are new forms established by natural selection, but the old forms, when they exactly fit the mould presented as it were for competitive filling, are maintained by the same unremitting process. A distinctive quality in the beauty of natural productions in which man delights is due to the unobtrusive yet tremendous slaughter of the unfit which is incessantly going on, and the absolute restriction of the privilege of parentage to the happy few who attain to the standard described as 'the fittest.'

7. The Limited Variety of Nature's Products.

The process of development of an immense variety of animal and vegetable for[illegible]roceeded in this

way through countless ages of geologic time, but it must not be supposed that any and every conceivable form and variety has been produced. There are only two great diverging lines of descent from original living matter—only the animals and the plants. And in each of these there are and have been only a limited number of branches to the pedigree—some coming off at a lower level, others at higher points when more elaborate structure has been attained. It is easy to imagine groups of both plants and animals with characters and structures which have never existed and never will exist. The limitation of the whole process in spite of its enormous duration in time, its gigantic output and variety, is a striking and important fact. Linnaeus said, 'There are just as many species as in the beginning the Infinite Being created'; and the modern naturalist can go no further than the paraphrase of this, and must say, 'There are and have been just so many and just so few varieties of animal and vegetable structure on this earth as it was possible for the physical and chemical contents of the still molten globe to form up to the hour now reached.'

8. The Emergence of Man.

As to how and when man emerged from the terrestrial animal population so strictly controlled and moulded by natural selection is a matter upon which we gain further information year by year. There must be many here who remember, as I do, the astounding and almost sudden discovery some forty-five years ago of abundant and overwhelming evidence that man had existed in Western Europe as a contemporary of the mammoth and rhinoceros, the hyaena and the lion. The dispute

over the facts submitted to the scientific world by Boucher de Perthes was violent and of short duration. The immense antiquity of man was established and accepted on all sides just before Mr. Darwin published his book on *The Origin of Species.* The palaeolithic implements, though not improbably made 150,000 years ago, do not, any more than do the imperfect skulls occasionally found in association with them, indicate a condition of the human race more monkey-like than is presented by existing savage races. The implements themselves are manufactured with great skill and artistic feeling. Within the last ten years much rougher flint implements, of peculiar types, have been discovered in gravels which are 500 feet above the level of the existing rivers. These Eoliths of the South of England indicate a race of men of less-developed skill than the makers of the Palaeoliths, and carry the antiquity of man at least as far back beyond the Palaeoliths as these are from the present day. We have as yet found no remains giving the direct basis for conclusions on the subject; but judging by the analogy (not by any means a conclusive method) furnished by the history of other large animals now living alongside of man—such as the horse, the rhinoceros, the tapir, the wolf, the hyaena, and the bear—it is not improbable that it was in the remote period known as the lower Miocene—remote as compared with the gravels in which Eoliths occur—that Natural Selection began to favour that increase in the size of the brain of a large and not very powerful semi-erect ape which eventuated, after some hundreds of thousands of years, in the breeding-out of a being with a relatively enormous brain-case, a skilful hand, and an inveterate tendency to throw stones, flouri-

sticks, protect himself in caves, and in general to defeat aggression and satisfy his natural appetites by the use of his wits rather than by strength alone—in which, however, he was not deficient. Probably this creature had nearly the full size of brain and every other physical character of modern man, although he had not as yet stumbled upon the art of making fire by friction, nor converted his conventional grunts and groans, his screams, laughter, and interjections into a language corresponding to and thenceforth developing his power of thought.

9. The Enlarged Brain.

The leading feature in the development and separation of man from amongst other animals is undoubtedly the relatively enormous size of the brain in man, and the corresponding increase in its activities and capacity. It is a very striking fact that it was not in the ancestors of man alone that this increase in the size of the brain took place at this same period, viz. the Miocene. The great mammals such as the titanotherium, which represented the rhinoceros in early Tertiary times, had a brain which was in proportion to the bulk of the body, not more than one-eighth the volume of the brain of the modern rhinoceros. Other great mammals of the earlier Tertiary period were in the same case; and the ancestors of the horse, which are better known than those of any other modern animal, certainly had very much smaller brains in proportion to the size of their bodies than has their descendant.

We may well ask to what this sudden and marked increase in the size of the brain in several lines of the animal pedigree is due. It seems that the inborn

hereditary nervous mechanism by which many simple and necessary movements of the body are controlled and brought into relation with the outer world acting upon the sense-organs, can be carried in a relatively small bulk of brain-substance. Fish, lizards, and crocodiles with their small brains carry on a complex and effective life of relation with their surroundings. It appears that the increased bulk of cerebral substance means increased 'educability'—an increased power of storing up individual experience—which tends to take the place of the inherited mechanism with which it is often in antagonism. The power of profiting by individual experience, in fact educability, must in conditions of close competition be, when other conditions are equal, an immense advantage to its possessor. It seems that we have to imagine that the adaptation of mammalian form to the various conditions of life had in Miocene times reached a point when further alteration and elaboration of the various types, which we know then existed, could lead to no advantage. The variations presented for selection in the struggle for existence presented no advantage—the 'fittest' had practically been reached, and was destined to survive with little change. Assuming such a relative lull in the development of mere mechanical form, it is obvious that the opportunity for those individuals with the most 'educable' brains to defeat their competitors would arise. No marked improvement in the instrument being possible, the reward, the triumph, the survival would fall to those who possessed most skill in the use of the instrument. And in successive generations the bigger and more educable brains would survive and mate, and thus bigger and bigger brains be produced.

It would not be difficult (though not, perhaps, profitable) to imagine the conditions which have favoured the continuation of this process to a far greater length in the Simian line of the pedigree than in other mammalian groups. The result is that the creature called Man emerged with an educable brain of some five or six times the bulk (in proportion to his size and weight) of that of any other surviving Simian. Great as is this difference, it is one of the most curious facts in the history of man's development that the bulk of his brain does not appear to have continued to increase in any very marked degree since early Palaeolithic times. The cranial capacity of many savage races and of some of the most ancient human skulls is only a little less than that of the average man of highly-civilized race. The value of the mental activities in which primitive man differs from the highest apes may be measured in some degree by the difference in the size of the man's and the ape's brain; but the difference in the size of the brain of Isaac Newton and an Australian black-fellow is not in the remotest degree proportionate to the difference in their mental qualities. Man, it would seem, at a very remote period attained the extraordinary development of brain which marked him off from the rest of the animal world, but has ever since been developing the powers and qualities of this organ without increasing its size, or materially altering in other bodily features[4].

10. The Progress of Man.

The origin of Man by the process of Natural Selection is one chapter in man's history; another one begins

with the consideration of his further development and his diffusion over the surface of the globe.

The mental qualities which have developed in Man, though traceable in a vague and rudimentary condition in some of his animal associates, are of such an unprecedented power and so far dominate everything else in his activities as a living organism, that they have to a very large extent, if not entirely, cut him off from the general operation of that process of Natural Selection and survival of the fittest which up to their appearance had been the law of the living world. They justify the view that Man forms a new departure in the gradual unfolding of Nature's predestined scheme. Knowledge, reason, self-consciousness, will, are the attributes of Man. It is not my purpose to attempt to trace their development from lower phases of mental activity in man's animal ancestors, nor even to suggest the steps by which that development has proceeded. What we call the will or volition of Man—a discussion of the nature and limitation of which it would be impossible for me here to offer and is happily not necessary for my present purpose—has become a power in Nature, an *imperium in imperio*, which has profoundly modified not only man's own history but that of the whole living world and the face of the planet on which he exists. Nature's inexorable discipline of death to those who do not rise to her standard—survival and parentage for those alone who do—has been from the earliest times more and more definitely resisted by the will of Man. If we may for the purpose of analysis, as it were, extract man from the rest of Nature of which he is truly a product and part, then we may say that

Man is Nature's rebel. Where Nature says 'Die!' Man says 'I will live.' According to the law previously in universal operation, Man should have been limited in geographical area, killed by extremes of cold or of heat, subject to starvation if one kind of diet were unobtainable, and unable to increase and multiply, just as are his animal relatives, without losing his specific structure and acquiring new physical characters according to the requirements of the new conditions into which he strayed, without in fact becoming a new morphological 'species.' But man's wits and his will have enabled him to cross rivers and oceans by rafts and boats, to clothe himself against cold, to shelter himself from heat and rain, to prepare an endless variety of food by fire, and to 'increase and multiply' as no other animal without change of form, without submitting to the terrible axe of selection wielded by ruthless Nature over all other living things on this globe. And as he has more and more obtained this control over his surroundings, he has expanded that unconscious protective attitude towards his immature offspring which natural selection had already favoured and established in the animal race, into a conscious and larger love for his tribe, his race, his nationality, and his kind. He has developed speech, the power of communicating, and above all of recording and handing on from generation to generation, his thought and knowledge. He has formed communities, built cities, and set up empires. At every step of his progress man has receded further and further from the ancient rule exercised by Nature. He has advanced so far and become so unfitted to the earlier rule, that to suppose that Man can 'return to Nature' is as unreasonable as to

suppose that an adult animal can return to its mother's womb.

In early tribal times natural selection still imposed the death penalty on failure. The stronger, the more cunning, the better armed, the more courageous tribe or family group, exterminated by actual slaughter or starvation the neighbouring tribes less gifted in one or all of these qualities. But from what we know of the history of warlike exterminating savage tribes at the present day—as, for instance, the Masai of East Africa—it seems unlikely that the method of extermination—that is, of true natural selection—had much effect in man's development after the very earliest period. Union and absorption were more usual results of the contact of primitive tribes than struggles to the death. The expulsion of one group by another from a desired territory was more usual than the destruction of the conquered. In spite of the frequent assertions to the contrary, it seems that neither the more ancient wars of mankind for conquest and migration nor the present and future wars for commercial privilege have any real equivalence to the simple removal by death of the unfit and the survival and reproduction of the fit, which we know as Natural Selection[5].

The standard raised by the rebel man is not that of 'fitness' to the conditions proffered by extra-human nature, but is one of an ideal comfort, prosperity, and conscious joy in life—imposed by the will of man and involving a control and in important respects a subversion of what were Nature's methods of dealing with life before she had produced her insurgent son. The progress of ma[illegible] acquirement of this control of

Nature has been one of enormous rapidity within the historical period, and within the last two centuries has led on the one hand to immensely increased facilities in the application of mechanical power, in locomotion, in agriculture, and in endless arts and industries; and on the other hand to the mitigation of disease and pain. The men whom we may designate as 'the Nature-searchers'—those who founded the New Philosophy of the Invisible College at Oxford and the Royal Society in London—have placed boundless power in the hands of mankind.

II. The Attainment by Man of the Knowledge of his Relations to Nature.

But to many the greatest result achieved by the progress of Natural Knowledge seems not to have been so much in its practical applications and its material gifts to humanity as in the fact that Man has arrived through it at spiritual emancipation and freedom of thought.

In the latter part of the last century man's place in Nature became clearly marked out by the accumulation of definite evidence. The significance and the immeasurable importance of the knowledge of Nature to philosophy and the highest regions of speculative thought are expressed in the lines of one who most truly and with keenest insight embodied in his imperishable verse the wisdom and the aspirations of the Victorian age:—

> 'Flower in the crannied wall,
> I pluck you out of the crannies:
> I hold you here, root and all, in my hand
> Little flower——but if I could understand
> What you are, root and all, and all in all,
> I should know what God and man is.'

To many the nearer approach to that 'understanding' has seemed the greatest and a sufficient result of scientific researches. The recognition that such an understanding leads to such vast knowledge would seem to ensure further and combined effort to bring it nearer and nearer to the complete form, even if the perfect understanding of the 'all in all' be for ever unattainable. Nevertheless, the clearer apprehension, so recently attained, of man's origin and destiny, and of the enormous powers of which he has actually the control, has not led to any very obvious change in the attitude of responsible leaders of human activity in the great civilized communities of the world. They still attach little or no importance to the acquirement of a knowledge of Nature: they remain fixed in the old ruts of traditional ignorance, and obstinately turn their faces towards the past, still believing that the teachings and sayings of antiquity and the contemplation, not to say the detailed enumeration, of the blunders and crimes of its ancestors, can furnish mankind with the knowledge necessary for its future progress. The comparative failure of what may be called the speculative triumph of the New Philosophy to produce immediate practical consequences has even led some among those prejudiced by custom and education in favour of the exclusive employment of man's thought and ingenuity in the delineation and imaginative resurrection of the youthful follies and excesses of his race, to declare that the knowledge of Nature is a failure, the New Philosophy of the Nature-searchers a fraud. Thus the well-known French publicist M. Brunettière has taken upon himself to declare what he calls the Bankruptcy of Science.

self from the destructive methods of natural selection, has accumulated a new series of dangers and difficulties with which he must incessantly contend.

14. Man and Disease.

In the extra-human system of Nature there is no disease and there is no conjunction of incompatible forms of life, such as Man has brought about on the surface of the globe. In extra-human Nature the selection of the fittest necessarily eliminates those diseased or liable to disease. Disease both of parasitic and congenital origin occurs as a minor phenomenon. The congenitally diseased are destroyed before they can reproduce: the attacks of parasites great and small either serve only to carry off the congenitally weak, and thus strengthen the race, or become harmless by the survival of those individuals which, owing to peculiar qualities in their tissues, can tolerate such attacks without injury, resulting in the establishment of immune races. It is a remarkable thing—which possibly may be less generally true than our present knowledge seems to suggest—that the adjustment of organisms to their surroundings is so severely complete in Nature apart from Man, that diseases are unknown as constant and normal phenomena under those conditions. It is no doubt difficult to investigate this matter, since the presence of Man as an observer itself implies human intervention. But it seems to be a legitimate view that every disease to which animals (and probably plants also) are liable, excepting as a transient and very exceptional occurrence, is due to Man's interference. The diseases of cattle, sheep, pigs, and horses, are not known

except in domesticated herds and those wild creatures to which Man's domesticated productions have communicated them. The trypanosome lives in the blood of wild game and of rats without producing mischief. The hosts have become tolerant of the parasite. It is only when man brings his unselected, humanly-nurtured races of cattle and horses into contact with the parasite, that it is found to have deadly properties[7]. The various cattle-diseases which in Africa have done so much harm to native cattle, and have in some regions exterminated big game, have *per contra* been introduced by man through his importation of diseased animals of his own breeding from Europe. Most, if not all, animals in extra-human conditions, including the minuter things such as insects, shell-fish, and invisible aquatic organisms, have been brought into a condition of 'adjustment' to their parasites as well as to the other conditions in which they live: it is this most delicate and efficient balance of Nature which Man everywhere upsets. A solitary case of a ravaging epidemic constantly recurring amongst animals living in extra-human conditions, one of a strangely interesting character, is the phosphorescent disease of the sand-shrimps or sand-hoppers. This is due to a microscopic parasite, a bacterium, which infests the blood and is phosphorescent, so that the infected sand-hopper has at night the brilliancy of a glow-worm. The disease is deadly, and is common among the sand-hoppers dwelling in the sandy flats of the north coast of France, where it may readily be studied[8]. It has not been recorded as occurring in this country. It is not at all improbable that this disease is also in truth one which only

occurs in the trail of man. It is quite likely that the artificial conditions of sewage and garbage set up by man on the sea-coast are responsible for the prevalence of this parasite, and the weakly receptivity of the too-numerous sand-hoppers.

It is probable enough that, from time to time, under the influence of certain changes of climate and associated fauna and flora—due to meteoric or geologic movements—parasitic disease has for a time ravaged this or that species newly exposed to it; but the final result is one or other of the alternatives, extinction or adjustment, death or toleration. The disease does not establish itself as a scourge against which the diseased organism incessantly contends. It either obliterates its victim or settles down with it into relations of reciprocal toleration.

Man does not admit this alternative either for himself or for the domesticated and cultivated organisms which he protects. He 'treats' disease, he staves off 'the adjustment by death,' and thus accumulates vast populations of unadjusted human beings, animals and plants, which from time to time are ravaged by disease—producing uncertainty and dismay in human society. Within the past few years the knowledge of the causes of disease has become so far advanced that it is a matter of practical certainty that, by the unstinted application of known methods of investigation and consequent controlling action, all epidemic disease could be abolished within a period so short as fifty years. It is merely a question of the employment of the means at our command. Where there is one man of first-rate intelligence employed in detecting the disease-producing parasites, their special conditions of

life and the way to bring them to an end, there should be a thousand. It should be as much the purpose of civilized governments to protect their citizens in this respect as it is to provide defence against human aggression. Yet it is the fact that this immensely important control of a great and constant danger and injury to mankind is left to the unorganized inquiries of a few enthusiasts. So little is this matter understood or appreciated, that those who are responsible for the welfare of States, with the rarest exceptions, do not even know that such protection is possible, and others again are so far from an intelligent view as to its importance, that they actually entertain the opinion that it would be a good thing were there more disease in order to get rid of the weakly surplus population!

Six weeks ago I was enabled to examine in the Pasteur Institute in Paris, the minute spiral thread which has just been discovered and shown to be the cause of the most terrible and widely spread of human diseases, destroying the health and strength of those whom it does not kill and damaging the lives of their children, so that it has been justly said that this malady and the use of alcohol as a beverage are together responsible for more than half the disease and early death of the mature population of Europe. For more than thirty years a few workers, here and there, have been searching for this parasite and the means of suppressing the awful curse of which it is the instrument. It would have been discovered many years ago had greater value been set on the inquiries which lead to such discoveries by those who direct the public expenditure of civilized States. And now the complete suppression of this dire enemy of humanity is as plain

and certain a piece of work to be at once accomplished as is the building of an ironclad. But it will not be done for many years because of the ignorance and unbelief of those who alone can act for the community in such matters. The discovery—the presentation to the eye and to exploring manipulation—of that well-nigh ultra-microscopic germ of death, seemed to me, as I gazed at its delicate shape, a thing of greater significance to mankind than the emendation of a Greek text or the determination of the exact degree of turpitude of the statesmen of a bygone age.

The knowledge of the causation of disease by bacterial and protozoic parasites is a thing which has come into existence, under our very eyes and hands, within the last fifty years. The parasite, and much of its nature and history, has been discovered in the case of splenic fever, leprosy, phthisis, diphtheria, typhoid fever, glanders, cholera, plague, lock-jaw, gangrene, septic poisoning (of wounds), puerperal fever, malaria, sleeping sickness, and some other diseases which are fatal to man. In some cases the knowledge obtained has led to a control of the attack or of the poisonous action of the parasite. Antiseptic surgery, by defeating the poisonous parasite, has saved not only thousands upon thousands of lives, but has removed an incalculable amount of pain. Control is slowly being obtained in regard to several others among these deadly microbes in various ways, most wonderful of which is the development, under man's control, of serums containing anti-toxins appropriate to each disease, which have to be injected into the blood as the means of either cure or protection. But why should we be content to wait long years, even centuries, for this control, when

we can have it in a few years? If more men and abler men were employed to study and experiment on this matter, we should soon make an end of all infectious disease. Is there any one, man or woman, who would not wish to contribute to the removal from human life of the suffering and uncertainty due to disease, the anguish and misery caused by premature death? Yet nothing is done by those who determine the expenditure of the revenues of great States towards dealing adequately with this matter[9].

15. The Increase of Human Population.

Whilst there is a certainty of Man's power to remove all disease from his life, a difficulty which he has already created for himself will be thereby increased. That difficulty is the increase of human population beyond the capacity of the earth's surface to provide food and the other necessities of life. By rebelling against Nature's method, Man has made himself the only animal which constantly increases in numbers. Whenever disease is controlled his increase will be still more rapid than at present. At the same time no attempt at present has been made by the more advanced communities of civilized men to prevent the multiplication of the weakly or of those liable to congenital disease. Already something like a panic on this subject has appeared in this country. Inquiries have been conducted by public authorities. But the only possible method of dealing with this matter, and in the first place of estimating its importance as immediate or remote, has not been applied. Man can only deal with this difficulty created by his own departure from Nature—to which he can never return—by investi-

gating the laws of breeding and heredity, and proceeding to apply a control to human multiplication based upon certain and indisputable knowledge. It may be a century, or it may be more than five centuries, before the matter would, if let alone, force itself upon a desperate humanity, brutalized by over-crowding and the struggle for food. A return to Nature's terrible selection of the fittest may, it is conceivable, be in this way in store for us. But it is more probable that humanity will submit, before that condition occurs, to a restriction by the community in respect of the right to multiply, with as good a grace as it has given up the right to murder and to steal. In view of this Man must, in entering on his kingdom, at once proceed to perfect those studies as to the transmission of qualities by heredity which have as yet been only roughly carried out by breeders of animals and horticulturists.

There is absolutely no provision for this in any civilized community, and no conception among the people or their leaders that it is a matter which concerns any one but farmers.

16. An Untouched Source of Energy.

The applications of steam and electricity have so far astonished and gratified the rebel Man, that he is sometimes disposed to conclude that he has come to the end of his powers in relieving himself from the use of his own muscles for anything but refined movements and well-considered health-giving exercises. One of the greatest of chemical discoverers at this time living, M. Berthelot, has, however, recently pressed on our attention the question of the possibility of tapping the central heat of the earth and making use of it as a

perennial source of energy. Many competent physicists have expressed the opinion that the mechanical difficulties of such a boring as would be necessary are insuperable. No one, however, would venture to prophesy, in such a matter as this, that what is prevented by insuperable obstacles to-day may not be within our powers in the course of a few years.

17. Speculations as to the Martians.

Such audacious control of the resources of our planet is suggested as a possibility, a legitimate hope and aim, by recent observations and speculations as to our neighbour, the planet Mars. I do not venture to express any opinion as to the interpretation of the appearances revealed by the telescope on the surface of the planet Mars, and indeed would take the most sceptical attitude until further information is obtained. But the influence of these statements about Mars on the imagination and hopes of Man seems to me to possess considerable interest. The markings on the surface of the planet Mars, which have been interpreted as a system of canals, have been known and discussed for many years. It has recently been observed that these canals undergo a recurrent seasonal change of appearance consistent with the hypothesis that they are periodically filled with water, which is derived from the polar snow-caps of the planet at the season of greatest polar heat. It is suggested that Mars is inhabited by an intelligent population, not necessarily closely similar to mankind, but, on the contrary, unlike mankind in proportion as the conditions of Mars are unlike those of the Earth, and that these inhabitants have constructed by their own efforts the enormous irrigation works upon which

the fertility and habitability of their planet, at the present time, depend. These speculations lead M. Faguet of the French Academy to further reflections. The Martians who have carried out this vast manipulation of a planet must be not only far in advance of the inhabitants of the Earth in intelligence and mechanical power, as a result of the greater age of their planet and the longer continuance there of the evolution of an intelligent race, but such a vast work and its maintenance would seem to imply a complete unanimity among the Martians, a world-wide peace and common government. Since we can imagine such a result of the prolonged play of forces in Mars, similar to those at work in our own Earth, and even obtain some slight confirmation of the supposition, may we not indulge in the surmise that some such future is in store for Man, that he may be able hereafter to deal with great planetary factors to his own advantage, and not only draw heat from the bowels of the earth for such purposes as are at present within his scope, but even so as to regulate, at some distant day, the climates of the earth's surface, and the winds and the rain which seem now for ever beyond his control?

18. The Investigation of the Human Mind.

In such a desultory survey as that on which I have ventured, of Man's kingdom and its dangers, it occurs to me to mention another area upon which it seems urgent that the activities of nature-searchers should be immediately turned with increased power and number. The experimental study of his body and of that of animals has been carried far and with valuable results by inquiring Man. But singularly small attention has

yet been given to the investigation of Man's mind as a natural phenomenon and one which can be better understood to the immense advantage of the race.

The mind of Man—it matters not for my immediate argument whether it be regarded as having arisen normally or abnormally from the mind of animals—is obviously the one and all-powerful instrument with which he has contended, and is destined hereafter to contend, against extra-human Nature. It is no less important for him to know the quality, the capacity, the mode of operation of this instrument, its beginnings and its limitations, than it is for him to know the minutest details of the workings of Nature. Just as much in the one case as in the other, it is impossible for him to trust to the imperfect analysis made by ancient races of men and the traditions and fancies handed down in old writings—produced by generations who had not arrived at the method of investigation which we now can apply. Experiment upon the mental processes of animals and of Man is greatly needed. Only here and there has anything been done in this direction. Most promising results have been obtained by such observations as those on hypnotism and on various diseased and abnormal states of the brain. But the subject is so little explored that wild and untested assertions as to the powers of the mind are current and have given rise to strange beliefs, accepted by many seriously-intentioned men and women. We boldly operate upon the minds of children in our systems of education without really knowing what we are doing. We blindly assume that the owners of certain minds, traditionally trained in amusing elegancies, are fit to govern their fellow men and administer vast provinces; we assume that the discovery and com-

prehension of Nature's processes must be the work of very few and peculiar minds; that if we take care of the body the mind will take care of itself. We know really nothing of the heredity of mental qualities, nor how to estimate their presence or absence in the young so as to develop the mind to greatest advantage. We know the pain and the penalty of muscular fatigue, but we play with the brains of young and old as though they were indestructible machinery. What is called experimental psychology is only in its infancy, but it is of urgent necessity that it should be systematically pursued by the application of public funds in order that Man may know how to make the best use of his only weapon in his struggle to control Nature.

19. Man's Delay: its Cause and Remedy.

Even the slight and rapid review just given of Man's position, face to face with Nature, enables us to see what a tremendous step he has taken, what desperate conditions he has created by the wonderful exercise of his will; how much he has done and can do to control the order of Nature, and how urgent it is, beyond all that words can say, for him to apply his whole strength and capacity to gaining further control, so that he may accomplish his destiny and escape from misery.

It is obvious enough that Man is, at present, doing very little in this direction; so little that one seeks for an explanation of his apathy, his seeming paralysis.

The explanation is that the masses of the people, in civilized as well as uncivilized countries, are not yet aware of the situation. When knowledge on this matter reaches, as it inevitably will in time, to the general population, it is certain that the democracy will demand that

those who expend the resources of the community, and as government officials undertake the organization of the defence and other great public services for the common good, shall put into practice the power of Nature-control which has been gained by mankind, and shall exert every sinew to obtain more. To effect this, the democracy will demand that those who carry on public affairs shall not be persons solely acquainted with the elegant fancies and stories of past ages, but shall be trained in the acquisition of natural knowledge and keenly active in the skilful application of Nature-control to the development of the well-being of the community.

It would not be necessary to wait for this pressure from below were the well-to-do class—which in most modern States exercises so large an influence both in the actual administration of Governments and by example—so situated as to be in any way aware of the responsibilities which rest upon it. Traditional education has, owing to causes which are not far to seek, deprived the well-to-do class of a knowledge of, and interest in, Man's relation to Nature, and of his power and necessity to control natural processes. During the whole period of the growth of man's knowledge of Nature—that is to say, ever since the days of Bruno—the education of the well-to-do has been directed to the acquirement of entertaining information and elegant accomplishments, whilst 'useful knowledge' has been despised and obtained, when considered necessary, from lower-class 'workmen' at workmen's wages. It is of course not to be overlooked that there have been notable exceptions to this, but they have been exceptions. Even at the present day, in some

civilized States, a body of clerks, without any pretence to an education in the knowledge of Nature, headed by gentlemen of title, equally ignorant, are entrusted with, and handsomely paid and rewarded for, the superintendence of the armies, the navies, the agriculture, the public works, the fisheries, and even the public education of the State. When compelled to seek the assistance of those who have been trained in the knowledge of Nature (for even in these States there are a few such eccentric persons to be found), the officials demand that such assistance shall be freely given to them without pay, or else offer to buy the knowledge required at the rate paid to a copying clerk.

This state of things is not one for which it is possible to blame those who, in blissful ignorance, contentedly perform what they consider to be their duty to their country. There are, however, in many States institutions, of vast influence in the education of the whole community, known as Universities. In many countries they as well as the schools are directly controlled by the State. In England, however, we are happy in having free Universities, the older of which, though in some important respects tied down by law, yet have the power to determine almost absolutely, not only what shall be studied within their own walls, but what shall be studied in all the schools of the country frequented by the children of the well-to-do.

It is the pride of our ancient Universities that they are largely, if not exclusively, frequented by young men of the class who are going to take an active part in the public affairs of the country—either as politicians and statesmen, as governors of remote colonies, or as leaders of the great professions of the Church, the Law, and

Medicine. It would seem, then, that if these Universities attached a greater, even a predominant, importance to the studies which lead to the knowledge and control of Nature, the schools would follow their example, and that the governing class of the country would become acquainted with the urgent need for more knowledge of the kind, and for the immediate application in public affairs of that knowledge which exists.

It would seem that in Great Britain, at any rate, it would not be necessary, were the Universities alive to the situation, to await the pressure of democracy, but that a better and more rapid mode of development would obtain; the influential and trusted leaders of the community would set the example in seeking and using for the good of the State the new knowledge of Nature. The world has seen with admiration and astonishment the entire people of Japan follow the example of its governing class in the almost sudden adoption of the knowledge and control of Nature as the purpose of national education and the guide of State administration. It is possible that, in a less rapid and startling manner our old Universities may, at no distant date, influence the intellectual life of the more fortunate of our fellow citizens, and consequently of the entire community. The weariness which is so largely expressed at the present day in regard to human effort—whether it be in the field of politics, of literature, or of other art, or in relation to the improvement of social organization and the individual life—is possibly due to the fact that we have exhausted the old sources of inspiration, and have not yet learnt to believe in the new. The 'return to Nature,' which is sometimes vaguely put forward as a cure for the all-pervading 'taedium' of this age, is

perhaps an imperfect expression of the truth that it is time for civilized man not to return to the 'state of Nature,' but to abandon his retrospective attitude and to take up whole-heartedly the Kingdom of Nature which it is his destiny to rule. New hope, new life will, when he does this, be infused into every line of human activity: Art will acquire a new impulse, and politics become real and interesting. To a community which believes in the destiny of Man as the controller of Nature, and has consciously entered upon its fulfilment, there can be none of the weariness and even despair which comes from an exclusive worship of the past. There can only be encouragement in every victory gained, hope and the realization of hope. Even in the face of the overwhelming opposition and incredulity which now unhappily have the upper hand, the believer in the predestined triumph of Man over Nature can exert himself to place a contribution, however small, in the great edifice of Nature-knowledge, happy in the conviction that his life has been worth living, has counted to the good in the imperishable result.

20. The Influence of Oxford.

If I venture now to consider more specifically the influence exercised by the University of Oxford upon the welfare of the State and of the human community in general, in view of the conclusions which have been set forth in what has preceded, I beg to say that I do so with the greatest respect to the opinions of others who differ from me. When I say this I am not using an empty formula. I mean that I believe that there must be many here present who are fair-minded and disinterested, and have given special

attention to the matter of which I wish to speak, and who are yet very far from agreeing with me. I ask them to consider what I have said, and what I have further to say, in the same spirit as that in which I approach them.

It seems to me—and when I speak of myself I would point out that I am presenting the opinions of a large number of educated men, and that it will be better for me to avoid an egotistical attitude—it seems to us (I prefer to say) that the University of Oxford by its present action in regard to the choice and direction of subjects of study is exercising an injurious influence upon the education of the country, and especially upon the education of those who will hereafter occupy positions of influence, and will largely determine both the action of the State and the education and opinions of those who will in turn succeed them. The question has been recently raised as to whether the acquirement of a certain elementary knowledge of the Greek language should be required of all those who desire to pursue their studies in this University, and accordingly whether the teaching of the elements of this language should form a prominent feature in the great schools of this country. It seems to us that this is only part of a much larger question; namely, whether it is desirable to continue to make the study of two dead languages—and of the story of the deeds of great men in the past—the main if not the exclusive matter to which the minds of the youth of the well-to-do class are directed by our schools and universities. We have come to the conclusion that this form of education is a mistaken and injurious one. We desire to make the chief subject of education both in school and in

college a knowledge of Nature as set forth in the sciences which are spoken of as physics, chemistry, geology, and biology. We think that all education[10] should consist in the first place of this kind of knowledge, on account of its commanding importance both to the individual and to the community. We think that every man of even a moderate amount of education should have acquired a sufficient knowledge of these subjects to enable him at any rate to appreciate their value, and to take an interest in their progress and application to human life. And we think further that the ablest youths of the country should be encouraged to proceed to the extreme limit of present knowledge in one or other branch of this knowledge of Nature so as to become makers of new knowledge, and the possible discoverers of enduring improvements in man's control of Nature. No one should be educated so as to be ignorant of the importance of these things; and it should not be possible for the greatest talent and mental power to be diverted to other fields of activity through the fact that the necessary education and opportunity in the pursuit of the knowledge of Nature are withheld. The strongest inducements in the way of reward and consideration ought, we believe, to be placed before a young man in the direction of Nature-knowledge rather than in the direction of other and far less important subjects of study.

In fact, we should wish to see the classical and historical scheme of education entirely abandoned, and its place taken by a scheme of education in the knowledge of Nature.

At the same time let me hasten to say that few,

if any of us—and certainly not he who now addresses you—would wish to remove the acquirement of the use of languages, the training in the knowledge and perception of beauty in literary art, and the feeding of the mind with the great stories of the past, from a high and necessary position in every grade of education.

It is a sad and apparently inevitable accompaniment of all discussion of this matter that those who advocate a great and leading position for the knowledge of Nature in education are accused of desiring to abolish all study of literature, history, and philosophy. This is, in reality, so far from being the case that we should most of us wish to see a serviceable knowledge of foreign languages, and a real acquaintance with the beauties of English and other literature, substituted for the present unsuccessful efforts to teach effectively either the language or literature of the Greeks and Romans.

It should not be for one moment supposed that those who attach the vast importance which we do to the knowledge of Nature imagine that Man's spirit can be satisfied by exclusive occupation with that knowledge. We know, as well as any, that Man does not live by bread alone. Though the study of Nature is fitted to develop great mental qualities—perseverance, honesty, judgement, and initiative—we do not suppose that it completes Man's mental equipment. Though the knowledge of Nature calls upon, excites, and gratifies the imagination to a degree and in a way which is peculiar to itself, we do not suppose that it furnishes the opportunity for all forms of mental activity. The great joys of Art, the delights

and entertainment to be derived from the romance and history of human character, are not parts of it. They must never be neglected. But are we not justified in asserting that, for some two hundred years or more, these 'entertainments' have been pursued in the name of the highest education and study to the exclusion of the far weightier and more necessary knowledge of Nature? 'This should ye have done, and yet not left the other undone,' may justly be said to those who have conducted the education of our higher schools and universities along the pleasant lines of literature and history, to the neglect of the urgently-needed 'improvement of Natural Knowledge.' Nero was probably a musician of taste and training, and it was artistic and high-class music which he played while Rome was burning: so too the studies of the past carried on at Oxford have been charming and full of beauty, whilst England has lain, and lies, in mortal peril for lack of knowledge of Nature.

It seems to be beyond dispute that the study, firstly of Latin, and much more recently of Greek, were followed in this University and in grammar schools, not as educational exercises in the use of language, but as keys to unlock the store-rooms—the books—in which the knowledge of the ancients was contained. So long as these keys were needed, it was reasonable enough that every well-educated man should spend such time as was necessary in providing himself with the key. But now that the store-rooms are empty—now that their contents have been appropriated and scattered far and wide—in all languages of civilization, it seems to be merely an unreasoning continuation of superannuated custom to go on with the provision

of these keys. Such, however, is the force of habit that it continues: new and ingenious reasons for the practice are put forward, whilst its original object is entirely forgotten.

In the first place, it has come to be regarded as a mark of good breeding, and thus an end in itself, for a man to have some first-hand acquaintance with Latin and Greek authors, even when he knows no other literature. It is a fashion, like the wearing of a court dress. This cannot be held to justify the employment of most of the time and energy of youth in its acquirement.

A second reason which is now put forward for the practice is that the effort and labour expended on the provision of these keys—even though it is admitted that they are useless—is a wonderful and incomparably fine exercise of the mind, fitting it for all sorts of work. A theory of education has been enunciated which fits in with this defence of the continued attempt to compel young men to acquire a knowledge, however imperfect, of the Latin and Greek languages. It is held that what is called 'training the mind' is the chief, if not the only proper, aim of education; and it is declared that the continuation of the study of those once useful, but now useless, keys—Latin and Greek—is an all-sufficient training. If this theory were in accordance with the facts, the conclusion in favour of giving a very high place to the study so recommended would be inevitable. But the facts do not support this theory. Clever youths are taken and pressed into the study of Greek and Latin, and we are asked to conclude that their cleverness is due to these studies. On the other hand, we maintain that though the study

of grammar may be, when properly carried out, a valuable exercise, yet that it is easily converted into a worthless one, and can never in any case take the place of various other forms of mental training, such as the observation of natural objects, the following out of experimental demonstration of the qualities and relations of natural bodies, and the devising and execution of experiment as the test of hypothesis. Apart from 'training' there is the need for providing the mind with information as well as method. The knowledge of Nature is eagerly assimilated by young people, and no training in mental gymnastics can be a substitute for it or an excuse for depriving the young of what is of inestimable value and instinctively desired.

The prominence which is assigned to a familiarity with the details of history, more especially of what may be called biographical history, in the educational system favoured by Oxford, seems to depend on the same causes as those which have led to the maintenance of the study of Greek and Latin. To read history is a pleasant occupation which has become a habit and tradition. At one time men believed that history repeats itself, and it was thought to be a proper and useful training for one who would take part in public affairs to store his mind with precedents and picturesque narratives of prominent statesmen and rulers in far-off days and distant lands. As a matter of fact it cannot be shown that any statesman, or even the humblest politician, has ever been guided to useful action by such knowledge. History does not repeat itself, and the man who thinks that it does will be led by his fragmentary knowledge of stories of the past into serious blunders. To the fashionable journalist such biographical history

furnishes the seasoning for his essays on political questions of the day. But this does not seem to be a sufficient reason for assigning so prominent a place in University studies to this kind of history as is at present the case. The reason, perhaps, of the favour which it receives, is that it is one of the few subjects which a man of purely classical education can pursue without commencing his education in elementary matters afresh.

It would be a serious mistake to suppose that those who would give a complete supremacy to the study of Nature, in our educational system, do not value and enjoy biographical history for what it is worth as an entertainment; or further, that they do not set great value upon the scientific study of the history of the struggles of the races and nations of mankind, as a portion of the knowledge of the evolution of Man, capable of giving conclusions of great value when it has been further and more thoroughly treated as a department of Anthropology. What seems to us undesirable is, that mere stories and bald records of certain peoples should be put forward as matter with which the minds of children and young men are to be occupied, to the exclusion of the all-important matters comprised in the knowledge of Nature.

There are, it is well known, not a few who regard the present institution of Latin and Greek and so-called History, in the pre-eminent place which they occupy in Oxford and the great schools of the country, as something of so ancient and fundamental a character that to question the wisdom of that institution seems an odious proceeding, partaking of the nature of blasphemy. This state of mind takes its origin in a common error, due to the fact that a straightforward account of the

studies pursued in the University during the last five hundred years has never been written. Our present curriculum is a mere mushroom growth of the last century, and has no claim whatever to veneration. Greek was studied by but a dozen or two specialists in Oxford two hundred and fifty years ago. In those days, in proportion to what had been ascertained in that subject and could be taught, there was a great and general interest in the University in the knowledge of Nature, such as we should gladly see revived at the present day. As a matter of fact, it is only within the last hundred years that the dogma of compulsory Greek, and the value of what is now called a classical education, has been promulgated. These things are not historically of ancient date; they are not essentials of Oxford. We are therefore well within our right in questioning the wisdom of their continuance in so favoured a position, and we are warranted in expressing the hope that those who can change the policy of the University and Colleges in this matter will, at no distant day, do so.

It is sometimes urged that Oxford should contentedly resign herself to the overwhelming predominance given to the study of ancient elegance and historic wisdom within her walls. It is said that she may well be reserved for these delightful pursuits, whilst newer institutions should do the hard work of aiding man in his conquest of Nature. At first sight such a proposal has a tempting character: we are charmed with the suggestion that our beautiful Oxford should be enclosed by a ring fence and cut off for ever from the contamination of the world. But a few moments' reflection must convince most of us that such a treatment of

Oxford is an insult to her and an impossibility. Oxford is not dead. Only a few decades have passed—a mere fraction of her lifetime—since she was free from the oppression of grammar-school studies, and sent forth Robert Boyle and Christopher Wren to establish the New Philosophy of the Invisible College in London. She seems, to some of us, to have been used not quite wisely, perhaps not quite fairly, in the brief period which has elapsed since that time. Why should she not shake herself free again, and give, hereafter, most, if not the whole, of her wealth and strength to the urgent work which is actually pursued in every other University of the world as a chief aim and duty?

The fact that Oxford attracts the youth of the country to her, and so determines the education offered in the great schools, is a sufficient answer to those who wish to perpetuate the present employment of her resources in the subvention and encouragement of comparatively unimportant, though fascinating (even too fascinating), studies, to the neglect of the pressing necessary knowledge of Nature. Those who enjoy great influence in the affairs of the University tell us with pride that Oxford not only determines what our best schools shall teach, but has, as a main pre-occupation, the education of statesmen, pro-consuls, leaders of the learned professions, and members of parliament! Undoubtedly this claim is well-founded, and its truth is the reason why we cannot be content with the maintenance by the University of the compulsory study of Greek and Latin, and the neglect to make the study of Nature an integral and predominant part of every man's education.

To return to my original contention—the knowledge and control of Nature is Man's destiny and his greatest

NOTE 2 (p. 12).

There is a tendency among writers on Variation, as affording the opportunity for the operation of Natural Selection, to assume that the variations presented by organisms are minute variations in every direction around a central point. Those observers who have done useful work in showing the definite and limited character of organic variations have very generally assumed that they are opposing a commonly held opinion that variation is of this equally distributed character. I cannot find that Mr. Darwin made any such assumption; and it is certain, and must on reflection have been recognized by all naturalists, that the variations by the selection and intensification of which natural selection has produced distinct forms or species, and in the course of time altogether new groups of plants and animals, are strictly limited to definite lines rendered possible, and alone possible, by the constitution of the living matter of the parental organism. We have no reason to suppose that the offspring of a beetle could in the course of any number of generations present variations on which selection could operate so as to eventually produce a mammalian vertebrate; or that, in fact, the general result of the process of selection of favourable variations in the past has not been *ab initio* limited by the definite and restricted possibilities characteristic of the living substance of the parental organisms of each divergent line or branch of the pedigree.

NOTE 3 (p. 14).

M. Paul Bourget of the Académie Française is not only a charming writer of modern 'novels,' but claims to be a 'psychologist,' a title which perhaps may be conceded to every author who writes of human character. His works are so deservedly esteemed, and his erudition is, as a rule, so unassailable, that in selecting him as an example of the frequent misrepresentation, among literary men, of Darwin's doctrine, I trust that my choice may be regarded as a testimony of my admiration for his art. In his novel *Un*

Divorce, published in 1904, M. Bourget says: 'La lutte entre les espèces, cette inflexible loi de l'univers animal, a sa correspondance exacte dans le monde des idées. Certaines mentalités constituent de véritables espèces intellectuelles qui ne peuvent pas durer à côté les unes des autres' (Édition Plon, p. 317). This inflexible law of the animal universe, the struggle between species, is one which is quite unknown to zoologists. The 'struggle for existence,' to which Darwin assigned importance, is not a struggle between different species, but one between closely similar *members of the same species*. The struggle between species is by no means universal, but in fact very rare. The preying of one species on another is a moderated affair of balance and adjustment which may be described rather as an accommodation than as a struggle.

A more objectionable misinterpretation of the naturalists' doctrine of the survival of the fittest in the struggle for existence is that made by journalists and literary politicians, who declare, according to their political bias, either that science rightly teaches that the gross quality measured by wealth and strength alone can survive and should therefore alone be cultivated, or that science (and especially Darwinism) has done serious injury to the progress of mankind by authorizing this teaching. Both are wrong, and owe their error to self-satisfied flippancy and traditional ignorance in regard to nature-knowledge and the teaching of Darwin. The 'fittest' does not mean the 'strongest.' The causes of survival under Natural Selection are very far indeed from being rightly described as mere strength, nor are they baldly similar to the power of accumulating wealth. Frequently in Nature the more obscure and feeble survive in the struggle because of their modesty and suitability to given conditions, whilst the rich are sent empty away and the mighty perish by hunger.

NOTE 4 (p. 20).

A short discussion of this subject and the introduction of the term 'educability' was published in a paper by me,

Giard and Billet were obtained at Wimereux near Boulogne. I found the disease very abundant at Ouistreham near Caen in the summer of 1900. I have not observed it nor heard of its occurrence on the English coast. Sea-water commonly contains a free-living phosphorescent bacterium which can be cultivated in flasks of liquid food so as to give rich growths which glow like a lamp when the flask is agitated so as to expose the contents to oxidation. This bacterium is not, however, the cause of the 'phosphorescence' of the sea often seen on our coasts. That is due in most cases to a much larger organism, as big as a small pin's head, and known as *Noctiluca miliaris*.

NOTE 9 (p. 33).

As little is the question of the use and abuse of food and drink dealt with, as yet, by civilized man. As in many other matters man has carried into his later crowded, artificial, nature-controlling life habits and tendencies derived from savage prehistoric days, so has he perpetuated ways of feeding which are mere traditions from his early 'animal' days and have never been seriously called in question and put to proof. The persistence under new conditions of either habit or structure which belonged to old conditions may be attended with great danger and difficulty to an organism which changes, as man does, with great rapidity important features in its general surroundings and mode of life. This is in effect Metschnikoff's doctrine of 'désharmonies.' It is probable that in very early days when a tribe of primitive men killed a mammoth, they all rushed on to the dead monster and gorged as much of its flesh as they could swallow (cooked or possibly uncooked). They had to take in enough to last for another week or two—that is to say, until another large animal should be trapped and slain. Accordingly he who could eat most would be strongest and best able to seize a good share when the next opportunity arrived, and it naturally became considered an indication of strength, vigour, and future prosperity to be capable of gorging large quantities

of food. By means of the phrases 'enjoying a good appetite,' or 'a good trencherman,' or other such approving terms, civilized society still encourages the heavy feeder. The lower classes always consider a ravenous appetite to be an indication of strength and future prosperity in a child. Most healthy men, and even many women, in Western Europe attack their food and swallow it without sufficient mastication, and as though they did not hope to get another chance of feeding for a week or two to come. Medical men have never ventured to investigate seriously whether civilized man is doing best for his health in behaving like a savage about his food. It is their business to attend to the patient with a disordered digestion, but not to experiment upon the amount of food of various kinds which the modern man should swallow in order to avoid indigestion and yet supply his alimentary needs. No individual can possibly pay medical men to make these observations. It is the business of the State to do so, because such knowledge is not only needed by the private citizen, but is of enormous importance in the management of armies and navies, in the victualling of hospitals, asylums, and prisons. Thousands of tons of preserved meat have been wasted in recent wars because the reckless and ignorant persons who purchased the preserved meat to feed soldiers had never taken the trouble to ascertain whether preserved meat can be eaten by a body of men as a regular and chief article of diet. It appears that certain methods of preserving meat render it innutritious and impossible as a diet.

It is probable from recent experiment that we all, except those unfortunate few who do not get enough, eat about twice as much as we require, and that the superfluous quantity swallowed not only is wasted, but is actually a cause of serious illness and suffering. It surely is an urgent matter that these questions about food should be thoroughly investigated and settled. In the opinion of the most eminent physiologist of the United States (Professor Bowditch), we shall never establish a rational and healthy mode of feeding ourselves until we give up the barbarous but to some persons

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